Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A99.9
F764RN

United States
Department of
Agriculture

Forest Service

**Intermountain
Forest and Range
Experiment Station
Ogden, UT 84401**

Research Note
INT-337

November 1983

Seed Transfer Guidelines for Douglas-fir in Central Idaho

G. E. Rehfeldt[1]

NATL AGRIC LIBRARY
USDA
Received by: JYB
Indexing Branch

ABSTRACT

Seed transfer guidelines are presented for Douglas-fir in central Idaho. While geographically lateral transfers may be relatively broad, elevational transfers should be limited to ±330 feet from the elevation of the seed source.

KEYWORDS: seed transfer, seed zones, adaptive variation

By limiting the distance that seeds are moved from their origin, seed transfer guidelines provide assurance that planted trees are adapted to the environment in which they are planted. To assure adaptation, however, guidelines must be based on genetic differences among populations that reflect adaptations to natural environments. This note presents seed transfer guidelines for Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) in central Idaho. The guidelines are developed from patterns of adaptive variation presented previously (Rehfeldt 1983). Limits to seed transfer are defined as the minimum geographic or elevational interval across which differentiation is detected with a probability of about 80 percent (Rehfeldt 1979).

PATTERNS OF VARIATION

Analyses of eight variables reflecting growth potential and cold hardiness revealed that adaptation of Douglas-fir populations in central Idaho results from a balance between selection for high growth potential by mild environments and selection for cold hardiness by severe environments (Rehfeldt 1983). As a result, genetic differentiation among populations is closely related to the elevation, geographic setting, and climate of the seed origin. These variables, in fact, accounted for as much as 87 percent of the genetic variance among populations.

As elevation increases, the length of the frost-free period generally decreases. Consequently, elevation of the seed source is negatively associated with growth potential but positively associated with cold hardiness. These elevational clines, like those for Douglas-fir in northern Idaho (Rehfeldt 1979) and western Montana (Rehfeldt 1982), are steep. On the average, populations separated by 3,300 feet in central Idaho differ by 48 percent of the mean height of all populations (Rehfeldt 1983). In addition, populations separated by 3,300 feet are expected to differ by about 28 percent in damage from freezing when injury to all populations reaches 50 percent (Rehfeldt 1979).

Geographic patterns of genetic variation that are independent of elevation are also evident in central Idaho (fig. 1). These patterns are closely related to environmental gradients. Ross and Savage (1967) show that frost-free periods are the longest (up to 180 days) in the northwestern portion of the region but abruptly drop to less than 60 days toward the southeast. Patterns of genetic variation, illustrated in figure 1 by contours of relatively equal performance, duplicate the environmental patterns. When elevation is held constant, populations from the northwest express greater growth potential but lesser cold hardiness than populations from the southeast. On the average, populations located at similar elevations in adjacent contour bands (fig. 1) differ by 5 percent in 3-year height and by 3 percent in cold injury.

Seed Transfer

Patterns of genetic variation can be used to limit seed transfer by using the following information: (1) contour intervals (fig. 1) are scaled to a value of one-half the geographic distance at which differentiation could be detected (80 percent level), and (2) differences could be detected (80 percent level) among populations separated by 660 feet elevation. From this information, either discrete seed zones or floating transfer guidelines can be constructed.

Discrete seed zones are separate and distinct parcels of land. Such zones should include two contour bands and 660 feet elevation. Transfers from a single source should be limited to ±330 feet and ±1 contour.

[1]Plant Geneticist, located at Intermountain Station's Forestry Sciences Laboratory, Moscow, Idaho.

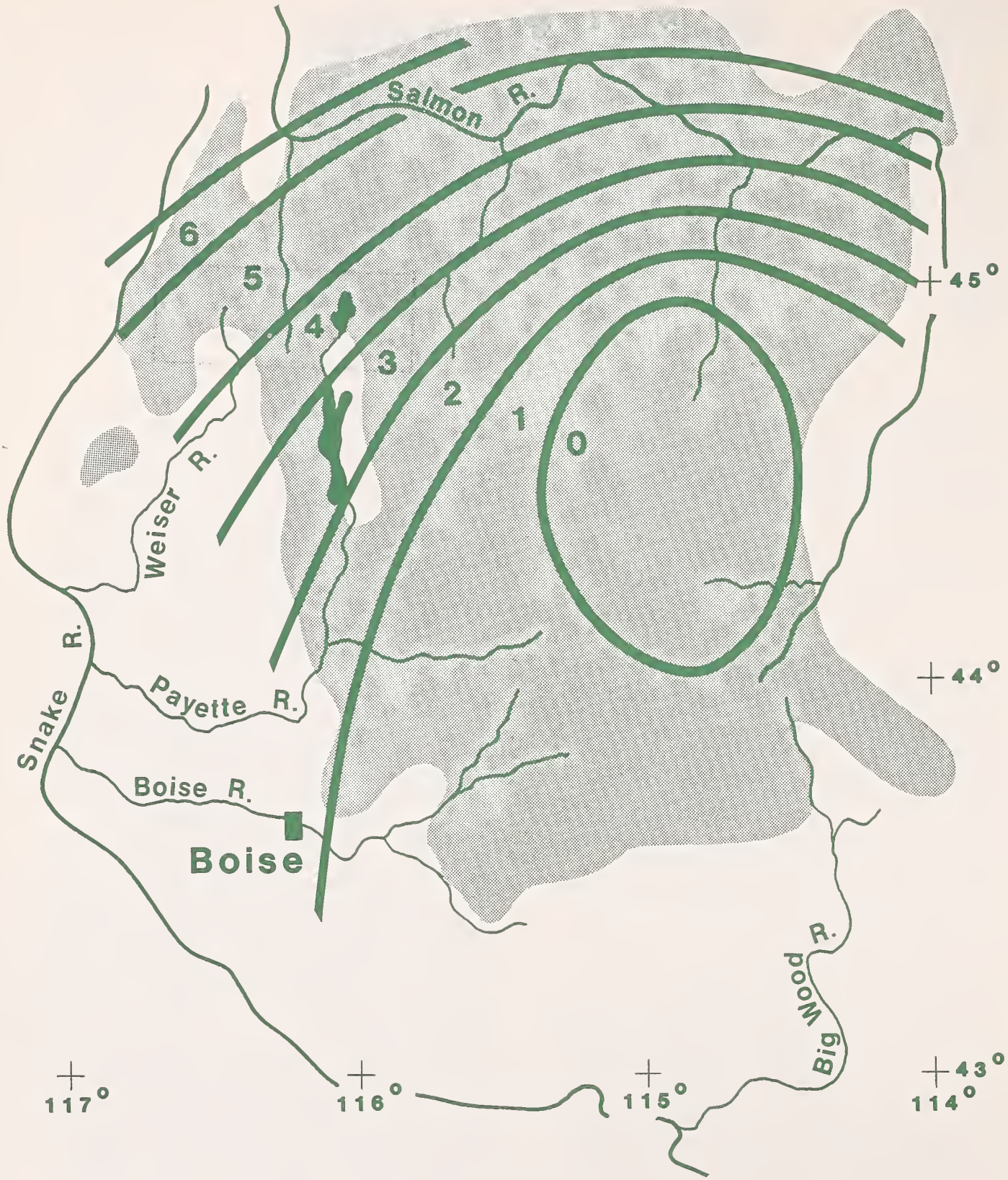

Figure 1. Geographic patterns of genetic variation among populations of Douglas-fir in central Idaho. The zero contour band depicts populations of lowest growth potential but highest cold hardiness.

Floating transfer guidelines are constructed from the relationship between elevational and geographic differentiation. From the genetic viewpoint, seed transfer from a contour band (fig. 1) of high numeric value to a band of low value is similar to a transfer of 330 feet upward in elevation within a band. Thus, seed can be transferred across contours; but each time a contour is crossed, an adjustment must be made in the elevational interval at which that seed is used. When seed is transferred across bands of decreasing numeric value, the appropriate elevational interval should be lowered by 330 feet for each contour crossed. When seed is transferred across bands of increasing numeric value, the interval should be increased by 330 feet. For example, if seed is collected from 4,500 feet in band 3, the seed may be used between 4,170 and 4,830 feet (4,500 ± 330) within that band. In band 2, it may be used between 3,840 and 4,500 feet (4,170 ± 330); in band 4, it may be used between 4,500 and 5,160 feet (4,830 ± 330). Seeds, however, should not be transferred across more than four bands. Regardless, floating transfer guidelines provide administrative flexibility; a single seed production area may serve several geographic bands.

Small geographic and narrow elevational limits to seed transfer may be impractical or uneconomical administratively. But expanding the recommended limits of seed transfer increases the risk of losses in productivity in two ways. First, whenever seed adapted to a severe environment is planted in a mild environment, growth potential, as compared to local populations, is reduced. Second, whenever seed from a mild environment is planted in a severe environment, damage from the cold is increased. Estimated losses average 5 percent in 3-year height and about 3 percent in frost injuries for each contour or for each 330 feet elevation that seed is moved from its origin.

The effects of seed transfer based on juvenile data cannot be transcribed accurately into productive losses of mature forests. Losses in productivity caused by maladaptation, however, accrue throughout the life cycle. Consequently, future information may require alteration of the present guidelines. Regardless, there is little doubt that dramatic consequences can develop from the indiscriminant transfer of Douglas-fir seeds in central Idaho.

REFERENCES

Rehfeldt, G. E. Ecological adaptations in Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) populations. I. North Idaho and northeast Washington. Heredity. 43: 383-397; 1979.

Rehfeldt, G. E. Ecological adaptations in Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) populations. II. Western Montana. Res. Pap. INT-295. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1982. 8 p.

Rehfeldt, G. E. Ecological adaptations in Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) populations. III. Central Idaho. Can. J. For. Res. 13: 626-632. 1983.

Ross, S. H.; Savage, C. N. Idaho earth science. Moscow, ID: Idaho Bureau of Mines; 1967. 271 p.

The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

The Intermountain Station includes the States of Montana, Idaho, Utah, Nevada, and western Wyoming. About 231 million acres, or 85 percent, of the land area in the Station territory are classified as forest and rangeland. These lands include grasslands, deserts, shrublands, alpine areas, and well-stocked forests. They supply fiber for forest industries; minerals for energy and industrial development; and water for domestic and industrial consumption. They also provide recreation opportunities for millions of visitors each year.

Field programs and research work units of the Station are maintained in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with the University of Montana)

Moscow, Idaho (in cooperation with the University of Idaho)

Provo, Utah (in cooperation with Brigham Young University)

Reno, Nevada (in cooperation with the University of Nevada)

U.S. GOVERNMENT PRINTING OFFICE: 1983—776-032/1049 REGION NO. 8